OPTICAL RESPONSE OF THE FXG SOLUTION TO DIFFERENT PHANTOM MATERIALS

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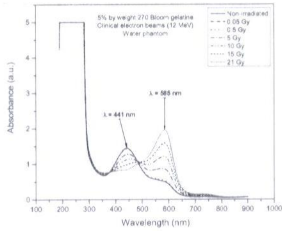
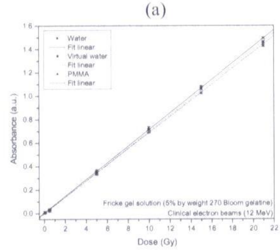
Introduction: In order to obtain the quality control in radiotherapy treatments using clinical electron beams, measurements such as absorbed dose determination must be performed and the recommended reference medium for this purpose is water (Andreo, 2004). However, when problems such as need of waterproofing sheaths to ionization chambers, other phantom materials (plastic phantoms) can be used (Williams, 1994). The purpose of this work is to evaluate the performance of the Fricke xylenol gel (FXG) solution developed at IPEN, prepared with 270 Bloom gelatine (made in Brazil), for clinical electron beams to the reference depth, using different phantom materials such as water and plastic [virtual water and polymethyl methacrylate (PMMA)] phantoms (Andreo, 2004). The color change, optical absorption spectra, dose response, lower detection limit, intra and inter batches reproducibility and energy, dose rate and angular dependent response were studied.

Materials and methods: The Fricke gel solutions were prepared (Olsson, 1989) and conditioned in PMMA cuvettes to perform the irradiations and measurements. The FXG samples were irradiated with clinical electron beams using VARIAN® linear accelerator model CLINAC 2100C (HIAE) with doses between 0.05 and 21 Gy, dose rates from 80 to 400 cGy.min^{-1} and electron energies from 4 to 16 MeV using water ($\rho = 1.00$ g.cm^{-3}), virtual water ($\rho = 1.03$ g.cm^{-3}) and PMMA ($\rho = 1.19$ g.cm^{-3}) phantoms. The evaluation technique was the spectrophotometry using a SHIMADZU® spectrophotometer model UV-2101PC (IPEN).

Results and discussion: The OA spectra obtained from FXG samples non-irradiated and irradiated using water phantom and the dose-response curves of FXG solutions irradiated using different phantom materials are presented in Figure 1 (a) and (b) respectively. The FXG solutions present two absorption bands: 441 nm (Fe^{2+}) and 585 nm (Fe^{3+}). The 441 nm band tends to disappear while the 585 nm band is intensified with increasing radiation doses (Figure 1a). In the Figure 1b can be observed the linear behaviour of the optical response for different phantom materials over the dose range studied. The small (< 4%) difference between the absorbance values obtained for the FXG solutions using water, virtual water and PMMA phantoms may be explained due to different densities of these materials.



(a)



(b)

Figure 1: Optical absorption spectra of FXG samples non-irradiated and irradiated with clinical electron beams using water phantom (a) and dose-response curves of FXG solutions using different phantom materials (b).

Conclusions: The FXG solution developed at IPEN prepared with 270 Bloom gelatine produced in Brazil provides excellent results when irradiated with clinical electron beams using different phantom materials. This datas indicates the viability of employ this solution in the dosimetry of the electron beams used in radiotherapy.

References:

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